Results on Three predictions on July 2012 Federal Elections in Mexico based on past regularities

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Abstract

July 2012 Presidential Election in Mexico has been the fourth occasion that the PREP, the Previous Electoral Results Program, works. PREP results give the voter turnout based in electoral certificates of each polling station that arrives to the capture centres. In the previous ones some statistical regularities had been observed, three of them were selected to made predictions and published in `arXiv:1207.0078 [physics.soc-ph]`. Two of the predictions were completely fulfilled and the third one was not measured since the electoral authorities changed the information in the data base for the 2012 process. The two confirmed predictions by actual measures are: (ii) The Partido Revolucionario Institucional is a sprinter and have a better performance in polling station which arrive late in the process. (iii) Distribution of vote of this party is well described by a smooth function named a Daisy model. A Gamma distribution, but compatible with a Daisy model, fits the distribution as well.

Key words: vote distribution, election, opinion polls, error analysis, election forensics

1. Introduction

In the last two decades electoral systems became an area of interest for physicist and mathematicians. A wide variety of theoretical models exists (see for instance [1] and references therein) but the results of actual data are much more scarce[2]-[11]. Predictions on the analysis of such data are appearing together with some theoretical frameworks to explain the regularities found in the "experimental" data. Notice that these approaches are far away from those made for the traditional political scientist.

Between the predictions we remark those of Borghesi [12] which have been successfully accomplished[13]. Here we present the results on the three predictions made before the July 2012 Mexican electoral process and made public [14]. As we shall see, two of them were successfully accomplished and the third one was incomplete due to the change in the official data presentation.

The analysis is performed on the dataset provided by the electoral authorities through the *Programa de Resultados Electorales Previos*, PREP or Previous Electoral Results Program. On how this program works see the official electoral authorities web page[15, 16] or the article [14]. On the peculiarities of the Mexican process see for instance [17](in English).

2. The Successful Predictions

As explained before, the experience gained analysing electoral data in Mexico allow us to extract some regularities appeared. In this section we present the two successful predictions for the July 2012 electoral process.

2.1. Prediction ii) The Partido Revolucionario Institucional (PRI) is a sprinter

Even when the behaviour presented here for the presidential candidates of the Partido Revolucionario Institucional appeared in both chambers election we shall concentrate in the presidential case. A graph of the percentage of vote for each party/candidate against the percentage of computed polling stations had been presented in voters turnout reports for federal elections in 2000 and 2006. In reference [10], version 3, both elections are reported. In Figure 1 and 2 the 2006 case, meanwhile in Figure 9 the 2000 case is presented. In all the analysed cases, the PRI presented a change in the percentage of votes slope. Beyond the 70% of computed polling stations an increase in the percentage of votes appeared. No matter that in both elections this party does not obtained the largest amount of votes, it appears ruling in polling stations arriving at the end of the counting process. It is a well known fact, due to historical reason, that PRI receive a lot of votes in geographical regions with a high marginalization index(see for instance [18]), such a regions are expected to have a slow electoral data process to the capture centres. This explain why PRI is a sprinter. In [14] the prediction was established as:

In the graph of percentage of vote against percentage of processed certificates the PRI will change its rate of grow around the 70% *of computed certificates. i.e. this political party has a good sprint.*

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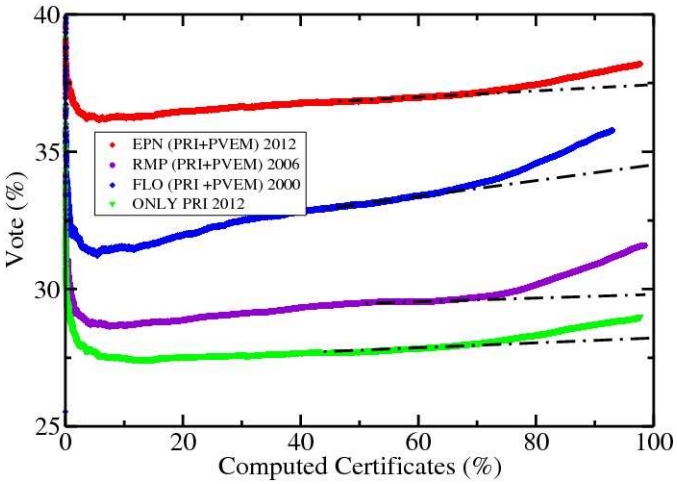

Figure 1: (Colour on-line) Percentage of votes obtained by the Partido Revolucionario Institucional, PRI, presidential candidate in the federal elections of 2012 (upper red line), 2006 (second from the bottomi in violet line), 2000 (third from the bottom in blue line) and percentage of votes for PRI alone in July 2012 process (first line in green). Straight dotted lines are for guide the eye. In 2000 and 2006 only the vote for coalition was admitted. For the 2012 process see explanation in the text. Notice that *in all* the cases the graph present a change in slope beyond 70% of computed certificates.

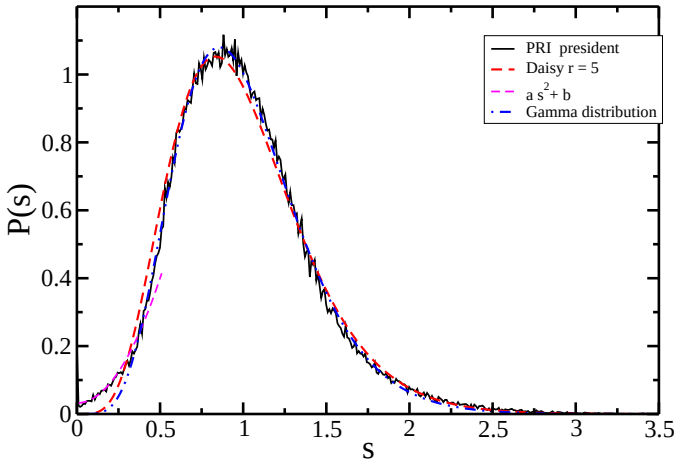

Figure 2: (Colour on-line) Comparison of the July 2012 PRI vote distribution for president (black line) with the two models. In broken red line a Daisy model of rank $r = 5$, equation (1,) in blue dot-line the Gamma distribution, eqaution (2) with the best fit. And in magenta broken line a quadratic polynomial which fits the distribution beginning. See text for details.

In order to test this prediction we report, in Figure 1, the percentage of vote obtained by the PRI against the percentage of computed certificates of the polling station. We report the presidential candidates in 2012 (EPN, Enrique Peña Nieto), 2006, (RMP, Roberto Madrazo Pintado) and, 2000 (FLO, Francisco Labastida Ochoa). For the July 2012 election the rules changed, candidates presented in a coalitions appeared in the ballot as the coalition and as the candidate of each party. So, we can differentiate the votes for PRI only, from those obtained as the options PRI+PVEM and PVEM alone. Hence, we present the PRI alone case as well. As can see in the Figure, for all the cases the PRI changes its grow slope, increasing, in a noticeable way, the percentage of votes. No matter if we analyse the PRI alone or the coalition. The change in slope is different in all the cases. The small party pertaining to the coalition present a typical small party behaviour, (not shown), as that presented in reference [10].

Seeing Figure 1 its is clear that prediction ii) has been accomplished.

Some small details about Figure 1. All the polling stations certificates were considered in the figure, which have small fluctuations that are not appreciable due to the plotting character size. The present figure was processed in order to keep the file of small size. The PREP record ends at certain hour, usually 24-26 hours after the capture begining and does not capture the 100% of the polling stations. So the end of records is different for each process.

2.2. Prediction iii) The PRI has a smooth vote distribution

Beyond the important discussion about universal features in the vote distribution in world wide electoral results, a corporate political party has been extremely regular: the Partido Revolucionario Institucional (PRI). In all the analysis previously performed,[10, 11, 19, 20] its vote distribution is a smooth function. In reference [11], the smooth behaviour of this party in federal elections 2000, 2003 and 2006 using the definitive dataset of Count by District was reported. Similar behaviour has been observed in 1997 and 1994 elections but has not been published.

The distribution of votes is the histogram of the number of polling stations with certain amount of votes, properly scaled and normalised in order to have a normalised to unity distribution with a mean unity as well. In order to do the comparison with probability distribution the amount of votes is "unfolded" or "deconvoluted" by using the average of number of votes, which scale properly the variable. The resulting histogram must be normalised to area one. (In reference [19] there is an explanation, but this procedure is standard in data treatment.)

After this process, a fitting with a model is possible. A model, named Daisy[21], of different ranks, was tested with success for the 2000, 2003 and 2006 electoral processes for the presidential and both chambers cases. The only free parameter in this model is the rank, r, and is written, for the nearest neighbours, as:

$$P_r(s) = \frac{(r+1)^{r+1}}{\Gamma(r+1)} s^r \exp[-(r+1)s]. \qquad (1)$$

With r integer and $\Gamma(\cdot)$ the Gamma function.

However, this distribution is a particular case of a more general distribution named Gamma distribution. It is characterised by two free parameters, α and θ [22, 23] and is written as:

$$P_\Gamma(s) = \frac{s^{\alpha-1}}{\Gamma(\alpha)\theta^\alpha} \exp[-\frac{s}{\theta}]. \qquad (2)$$

Here the free parameters are real numbers. When $\theta = 1/(r+1)$ and $\alpha = r+1$ we recover Eq. (1).

In this term, the third prediction was presented as:

The distribution of votes for PRI, in presidential and both chambers elections, could be fitted by a smooth distribution, in

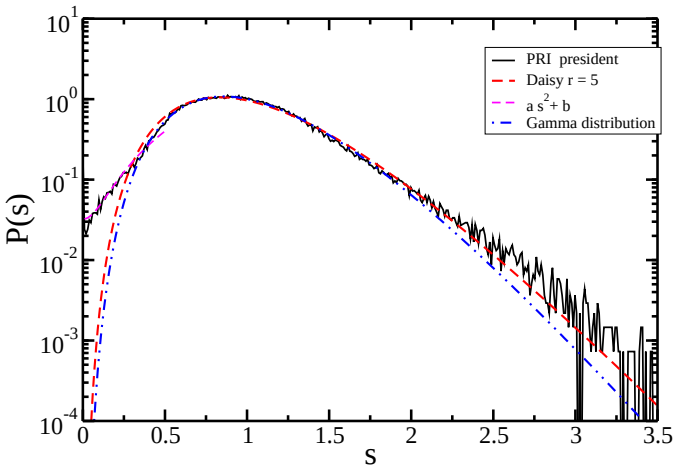

Figure 3: (Colour on-line) Same as the previous figure but in log-linear scale. See text for details.

general by a Gamma distribution or for those distributions of Daisy models.

The result for the 2012 case is presented in Figure 2 and corresponds only to the presidential case for the votes for PRI alone. We left the other cases to a future work. There, the normalised histogram is presented in black line. It is noticeable that the beginning of the distribution is not compatible with the fast decay at the tail and present an abrupt change in slope (not shown). Such behaviour certainly can be analysed with the Gamma distribution, but we keep the analysis apart since this kind of change in the slope has been reported for 2003 intermediate elections. There, the behaviour corresponds to a different dynamics. The beginning of the distribution in Figure 2 is fitted by a quadratic polynomial with no linear term.

For the rest part of the distribution we test our two models. In broken red line appears a Daisy model of rank $r = 5$ which follows the curve nicely. The tail is clearly compatible with this Daisy as can be seen in Figure 3, where the same plot is presented but in log-linear scale in order to observe the exponential decay. Notice that the Daisy model runs inside the tube of fluctuations. Other ranks of Daisy model does not fit the actual data.

In order to test how good the Daisy model is, we contrast with the Gamma distribution with two free parameters, equation (2). The fit was obtained for different starting points, since the change in slope is at $s \approx 0.4$. For fittings starting beyond this point the results are around $\alpha - 1 = 5.8$ and $1/\theta = 6.7$. All the results are compatible with a Daisy model, since the relation between α and θ remains as $1/\theta \approx \alpha$. Hence, **prediction iii) was accomplished, PRI have a smooth vote distribution described by Daisy models.**

A detailed analysis of the exact values of the parameters is irrelevant at this moment since we do not have a theoretical model that explain this smooth behaviour. There are efforts in this way [19, 20], but they are not totally satisfactory. Additionally, a mixture of results can be present since the histogram is bult up using the complete database and do not consider differences in district or state. It is important to notice that in several Mexican states the PRI rules since 1929. The analysis of PRI's distribution of vote performed by state and by district is in progress.

3. Conclusions

Any scientific work must provide of predictions, even when they could be based only on empirical observations. To have a theoretical framework for the regularities is a much more satisfactory result for physicist, but social systems are far to be understood and open a wide window for research, for physicist alone or for multidisciplinary approaches.

In this paper we offer evidence that Mexican elections as many others in several countries and years present regularities. In particular, the first accomplished prediction is result of history and geography, PRI has a well established promotional system that rules for many years. So, no magic intelligence need to be invoked in order to explain the time domain behaviour. Wider studies could confirm this. The second accomplished prediction is a much more delicate question. The appearance of probability distributions in a process is, in general, evidence of some sort of general principle behind it. Such is the case of Gaussian distributions or power laws. The appearance of a Daisy model in all the PRI electoral process could open a door to understand the corporate parties around the world.

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References

References

[1] Castellano, C., Fortunato, S., Loreto, V. Statistical physics of social dynamics. Rev. Mod. Phys. **81** (2009) 591-646.
[2] S. Fortunato and C. Castellano, Phys. Rev. Lett. **99** (2007) 138701.
[3] Borghesi C, Galam S. Phys. Rev. E **73** (6) (2006) 066118.
[4] Borghesi C., J-P. Bouchaud. Eur. Phys. J. B. **75** (2010) 395-404
[5] C. Borghesi, J.C. Raynal and J.P. Bouchaud. Election turnout in many countries: similarities, differences, and a diffusive field model for decision making. `arxiv:1201.0524v1` Jan 2, 2012
[6] Christian Borghesi, Jean Chiche, Jean-Pierre Nadal. "Between order and disorder: a 'weak law' on recent electoral behavior among urban voters? " arXiv:1202.6307v1 [physics.soc-ph]
[7] R.N. Costa Filho *et al* Phys. Rev E. **60**, 1067 (1999); Physica A **322** (2003) 698.
[8] A.A. Moreira, D.R. Paula, R.N. Costa Filho and J.S. Andrade Jr., Phys. Rev E. **73** (2006) 065101(R).
[9] M.C. Gonzalez, A.O. Sousa, and H.J. Herrmann, Int. J. Mod. Phys. C **15** (2004) 45.
[10] G. Báez, H. Hernández-Saldaña and R.A. Méndez-Sánchez. Previous versions of this work. `arXiv:physics/0609144` versions 1, 2 and 3.
[11] H. Hernández-Saldaña. Physica A **388** (2009) 2699. arXiv/physics:0810.0554.
[12] Borghesi, C.*Three quantitative predictions based on past regularities about voter turnout at the French 2009 European election.* arXiv:0905.4578v1 [physics.soc-ph]

[13] Borghesi, C. *Results of three quantitative predictions based on past regularities about voter turnout at the French 2009 European election* arXiv:0906.2692v1 [physics.soc-ph]
[14] H. Hernández-Saldaña. Three predictions on July 2012 Federal Elections in Mexico based on past regularities. `arXiv:1207.0078 [physics.soc-ph]`.
[15] `http://www.ife.org.mx`
[16] http://www.ife.org.mx/informacion-relevante.html
[17] Klesner, J.L., 2007. The July 2006 presidential and congressional elections in Mexico, Electoral Studies **26** 803-808.
[18] F. Pliego Carrasco. *El mito del fraude electoral en México.* (Pax México, 2007). In Spanish
[19] H. Hernández-Saldaña. Chapter 16. Travelling Salesman Problem, Theory and Applications. D. Davendra (Ed.) InTech. 2010.
[20] H. Hernández-Saldaña. M. Gómez Quesada and E. Hernández Zapata. Statistical distributions of quasi-optimal paths in the traveling salesman problem: The role of initial distribution of cities. *Rev. Mex. Fís. S.* **58**(1) (2012) 0032. Available at arXiv/physics:1003.3913v2 [cond.-math.stat-mech] 2011.
[21] H. Hernández-Saldaña, J. Flores and T.H. Seligman. Phys. Rev E. **60** (1999) 449.
[22] Beyer, W. H. CRC Standard Mathematical Tables, 28th ed. Boca Raton, FL: CRC Press, p. 534, 1987.
[23] Weisstein, Eric W. "Gamma Distribution." From MathWorld–A Wolfram Web Resource. http://mathworld.wolfram.com/GammaDistribution.html